Abstract—In this paper we analyze the current situation of education in universities, with particular reference to the European scenario. Specifically, we observe that recent evolutions, such as pervasive networking and other enabling technologies, have been dramatically changing human life, knowledge acquisition, and the way works are performed and people learn. In this societal change, universities must maintain their leading role. Historically, they set trends primarily in education but now they are called to drive the change in other aspects too, such as management, safety, and environment protection. The availability of newer and newer technology reflects on how the relevant processes should be performed in the current fast changing digital era. This leads to the adoption of a variety of smart solutions in university environments to enhance the quality of life and to improve the performances of both teachers and students. Nevertheless, we argue that being smart is not enough for a modern university. In fact, universities should better become smarter. By “smarter university” we mean a place where knowledge is shared between employees, teachers, students, and all stakeholders in a seamless way. In this paper we propose, and discuss a smarter university model, derived from the one designed for the development of smart cities.

Keywords—Smart cities; smart applications; collaborative systems; technology enhanced learning.

I. INTRODUCTION

At times, technological innovations have contributed to the creation of neologisms by introducing novel buzzwords such as, e.g., micro, cyber, virtual, which are used to identify the latest cutting-edge solutions. As an example, let us consider the prefix “e-”. The massive adoption of Internet and web-based solutions has suddenly given birth to e-mail, e-commerce, e-banking, e-learning, and many other modern terms. In many cases, the “e-” has been replaced by the suffix “2.0” to move the attention to a further evolutionary step of the same product. Now we have entered the smart-something era, in which the prefix “smart” is attached to devices with computing and/or network capabilities. Moreover, such devices offer some form of smartness since they are easy to use and designed to improve users experience in common operations. Hence, we make a daily use of smart-phones, smart-TVs, smart-fridges, and so on. Riding this wave, the prefix smart has also been applied to places (e.g., smart-city, smart-building, smart-museum), and concepts (e.g., smart-work, smart-power, smart-grid). In this context, the design of a smart-system should follow the human-centered design approach and exploit all available technologies to improve sustainability, environmental friendliness, reliability, mobility, and flexibility. In conclusion, smart systems and smart solutions are green, robust, personalized, responsive, interactive, and adaptive as well as accessible anytime, anywhere, from any device, according to the ubiquitous Internet paradigm.

In this scenario, we consider the concept of smart-university too. First of all, we notice that a commonly accepted definition is lacking in the literature. In particular, a tentative interpretation is given in [1], describing smart university as “a platform that acquires and delivers foundational data to drive the analysis and improvement of the teaching & learning environment,” by retrieving sensor-data, and using linked (open) data and formalized teaching knowledge. However, this is a merely technological approach and we observe that technology is just one among the many variables to take into account. In fact, recent modifications in laws and policy, also driven by economics and market analysis, are influencing universities’ learning environments and processes as well. Moreover, social issues, more recent innovations, and enabling technologies have been changing the way humans learn and thus are reshaping the relationship between learners and teachers.

These changes must be reflected in the university organization, which is asked to supply high quality services in order to stay competitive in a global scenario. This leads to the need for many modifications including the way in which teachers should work and in the creation of new models of students’ evaluation and assessment. As an example, one of the main changes recently observed in university teaching is the decrease in the amount of time for face-to-face lectures and accordingly, an increase in the amount of time for individual study, which is carried on by students mainly over the Internet. This new independent learning ability must be empowered by supplemental resources such as, e.g., video lessons, and scheduling of individual learning activities followed by self-evaluation. Moreover, the globalization process has dramatically accelerated the dynamics in production techniques and methodologies, thus requiring a more flexible education model, able to react quickly to unexpected changes whilst maintaining a high level quality. In addition, there are many human factors affecting the whole educational process. Among these, one of the most influential factors is that today’s students
have different attitudes and learning styles, derived from the highly interactive world they live in. Furthermore, the advent of social-media has influenced the way people use their knowledge across a distributed environment in a new collaborative fashion.

To cope with this reality, technology is no longer sufficient. We suggest that a paradigm change is necessary to transform a smart university into a smarter university, hence more efficient, more effective, and with a higher participation of both students and teachers, collaborating to achieve the common objective of better learning. In this respect the smarter university offers rich, interactive and ever-changing learning environments by exploiting the suite of technologies and services available through the Internet, by empowering individuals’ abilities and attitudes, and by encouraging them to interact and collaborate in a framework in which people are co-responsible for raising and appraising the inclination of everyone. To achieve this objective, in this paper we analyze the issues of the current reality and, finally, we propose a model for the smarter university.

The remainder of this paper is organized as follows: Section 2 is a review of smart education including users’ perspectives and a look at current and future trends; in Section 3 we outline the issues and the challenges of a smart educational ecosystem with reference to technologies, competences, and processes; in Section 4 we propose the model of a smarter university. Conclusions follow in Section 5.

II. SMART EDUCATION

Education in a smart environment supported by smart technologies, making use of smart tools and smart devices, can be considered smart education. In this respect, we observe that novel technologies have been widely adopted in schools and especially in universities, which, in many cases, exploit cloud and grid computing, Next Generation Network (NGN) services and portable devices, with advanced applications in highly interactive frameworks. Thus, we can say that smart universities are already here. Nevertheless, smart education is just the upper layer, though the most visible one, and other aspects must be considered such as:

- communication;
- social interaction;
- transport;
- management (administration and courses);
- wellness (safety and health);
- governance;
- energy management;
- data storage and delivery;
- knowledge sharing;
- IT infrastructure;
- environment.

In this respect, six key areas are identified [2] for the design of an iCampus, where “i” stands both for integrative and intelligent. Namely, these areas are: learning, management, governance, social, health, and green. Other researchers focus on the Knowledge Management (KM) aspects, stating that KM is the foundation of a smart university, since it is the cornerstone to fulfill business goals. Reference [3] describes a smart university as composed of five entities: smart people, smart building, smart environment, smart governance, and, last but not least, a knowledge grid. Other works address only technological solutions by outlining a smart space based on the use of RFID (Radio Frequency IDentification) technology [4] or providing NFC (Near Field Communication) support [5], [6]. To carry on with the overview of enabling infrastructure solutions, we must mention cloud computing as a resource for improving efficiency, cost, and convenience in the educational sector. Traditionally, cloud computing has been a convenient tool used in research laboratories for the optimization of computing resources. Today an increasing number of educational establishments are adopting cloud computing for economic reasons too [7].

A. Users' Perspective

From the users’ perspective, smart education is mainly related to the use of mobile web technology, which fosters a new conceptual model of mobile education in which teaching and learning activities are performed using ubiquitous computing. As an example, we mention the model proposed in [8], which deals with issues related to the usability of mobile applications and communication power among students and teachers. The paper refers to the FRAME model [9] and also includes a rich literature review that covers important concepts for the definition of new conceptual models, such as: the Transaction Distance Theory (DTD) [10], the Social Information Processing Theory (SIPT) [11], mobile web usability principles, cloud computing, and mobile web technology.

B. Current and Future Trends in Education

To conclude this brief analysis of related works, we mention the reports published by the New Media Consortium (NMC)¹, which contain interesting outlooks on trends in education and a perspective timeline for their adoption. For example, the 2012 edition [12] forecasted the success of mobile apps and tablet computing within one year or less, game-based learning and learning analytics adoption was indicated on a two to three years horizon, while gesture-based computing and the Internet of the Things (IoT) on a four to five years horizon. We still need time to see whether these estimates will be fully realized or not. In the 2013 edition [13], the main focus was on the success of Massive Open Online Courses (MOOC) in one year and new issues are 3D printing and wearable technology on a four to five years horizon. The current 2014 edition [14] highlights the key trends that are driving changes in higher education in the next years. Among these is mentioned the growing ubiquity of social media, the integration of online, hybrid and collaborative learning environments, the rise of data-driven learning and assessment, the shift from students as consumers to students as creators (a shift that will mark the

¹ http://nmc.org
definitive evolution of online learning). It is worth noting that in this work, the authors indicate the “low digital fluency of faculty” and the “lack of rewards for teaching” as challenges to be solved.

This general scenario and these last statements confirm the thesis at the basis of this paper: there is a need for the change of the current model of the modern university from smart to smarter.

III. ISSUES AND CHALLENGES IN SMART EDUCATION

According to the above situation, the university faces challenges to cope with novel learners’ needs, and to provide a seamless integration between the education production system (i.e., the education of the future workforce) and jobs, firms, industries, and organizations, which are requesting a multidisciplinary education with complementary competencies and skills ranging from humanities to technologies. It is not unusual to find job searches demanding experts in humanities with technology skills, as well as technicians with good communications skills. This reflects the need for a novel profile of professionals and experts, which are required to have “T-shaped” skills, where the T denotes a solid basic knowledge on a specific, even narrow, area, complemented by a wide, yet shallow, knowledge of common topics.

Unfortunately, today most graduates only have a deep knowledge in a specific discipline. In fact, on the one hand, humanities courses disregard education in technology and, on the other hand, technological curricula (e.g., engineering, computer science, and physics) do not take into account social matters and writing skills. This prevents young graduates from having immediate success in the global market, which is focused on services, human interaction, and activities performed in teams. In this scenario we need to foster collaboration among all the parts involved in education. Students should have the opportunity of interacting with companies and industries during their studies, so as to be able to orient themselves towards specific applications. Moreover, the tight collaboration between the university and the business world can provide multiple advantages, such as having classes based on up-to-date programs and the most advanced technologies, and facilitating the technology knowledge transfer from university research laboratories straight to industry.

To overcome these problems, we can rely on most recent evolution in Information and Communication Technologies (ICT), which offers technological infrastructures, suited services, and platforms. Internet, grids, and cloud computing provide technologies for the restructuring of traditional education environments by supporting the more effective paradigm of a university with distributed resources: a university in which everyone (i.e., students, teachers, IT and administrative personnel, etc.) is provided with a rich set of functionalities that help to perform her/his activities through ubiquitous devices either via mobile services or in an unstructured environment. In addition to this, the Web 2.0 has among its most common functionalities, the ability to enable people to fully exploit communication. Therefore it supports the implementation of the paradigm of collaborative work and collaborative learning. From the students’ point of view, collaborative learning can promote the generation of communities of practice and group activities, which can represent a advance look at the organization of the work field they will encounter in their forthcoming job, which, probably, will be asynchronous and geographically distributed.

A. Smart Technologies

In an ecosystem where learners, teachers, technicians and administrative personnel work together to improve the quality of their job results, technology plays a fundamental role, along with the individuals involved in the process. The most important points that we have identified are the following:

- The popularity of social network sites is dramatically changing interpersonal communication and the adoption of social media and networks in education is highly debated, especially in the community of pedagogy [15]. Social networks can become an alternative to traditional learning environments, and leverage a new generation of Learning Management Systems (LMS), especially for independent learning and communities of practice. Furthermore, social network sites are naturally related to the use of portable devices, thus fostering innovative mobile learning strategies as well.

- Cloud computing is changing software distribution and usage and its adoption deeply impacts on technological solutions. From the e-learning perspective, cloud and distributed computing support virtual laboratories [16] and extensive simulations, thus reducing machinery costs. Moreover, a mobile cloud-computing environment is the enabling technological framework for achieving effective functionalities for learning in mobility [17], [18].

- The use of smart devices fostered a new dimension in learning, especially from the students’ side, due to the continuous availability of network resources and advanced software programs. Modern mobile devices, especially tablets, make available a large number of applications in education. However this introduces problems from the providers’ side, especially due to privacy and security issues [19].

- Contactless technologies (e.g., Bluetooth, Quick Response Code, RFID, NFC) and modern network solutions are giving rise to novel interactive and immersive environments, some based on the IoT paradigm. Using interconnected smart objects results in multiple possibilities to design technology-enhanced learning activities [20]. Moreover, IoT can be exploited to deliver services to students within the university boundaries based on their position. In addition, location-based services coupled with contactless technology can be used to implement augmented reality systems.

- The evolution of the Web towards the Semantic Web (SW) is changing information retrieval techniques and content management. SW technology influences the way knowledge is organized and distributed. As an example, consider the adoption of a linked data-based
We professionals to share the same language for supply and administration offices, career schools, workers, and companies, across European universities. Transfer and Accumulation System). The ECTS represents a basic principle of sharing and collaboration. P2P is at the basis of file sharing systems, which can be used to circulate documents among people involved in the learning process, and to foster collaboration among peers by generating student-to-student relationships, thus facilitating the collaborative-learning model [24], [25], [26].

The wide availability of network connectivity and its broad diffusion is stimulating interactions among people and fostering the adoption of collaborative paradigms. In education as well, collaborative learning is assuming new aspects, especially through the adoption of specific collaborative environments designed to make the most of students’ teams effort (see, e.g., [27], [28], [29] and references therein).

We emphasize that smart education solutions must deal with most, if not all, of these topics. For example, social networking involves the use of mobile devices and introduces mobile learning, which relies on a cloud-computing distributed system. Moreover, using personal devices in an interactive environment implies the use of networked objects within the IoT, and so forth.

### B. Smart Competences

In today’s historical context, there is an additional force accelerating the evolution process of education, that is the requirement of new competencies in the ICT area. This force is generated by the advent of smart cities, which results in the creation of new jobs for new professionals. An expertise is a proven ability in applying knowledge, skills and attitudes to achieve measurable objectives. The European countries have been discussing in recent years the need for the creation of such competencies, and have produced: (i) a document titled “European Competence Framework (ECF)”, (ii) a website for the publication of the workforce [30], and (iii) a tool for building such competencies. The proposed approach is similar to the one already experienced in the European universities scenario with the introduction of the ECTS (European Credit Transfer and Accumulation System). The ECTS represents a sort of “currency” of knowledge in a given area and provides a measure of the contents acquired, guaranteeing the portability across European universities.

In the same way, ECF represents the currency for the relevant competencies, allowing large public and private companies, small and medium-sized enterprises, local and state administration offices, career schools, workers, and professionals to share the same language for supply and demand. Many vendors and big players too are currently mapping their certifications on the ECF requirements. ECF provides them with a tool to access a standard reference set of skills to apply for recruitment, placement, career paths, training, certification, etc. In other words, ECF provides a common European (and national) language to express the ICT skills.

This means that a person with a bouquet of skills can be identified through standard professional profiles that will be recognized across the European countries and, therefore, portable in terms of job opportunities. Hence, a smart university should have tools similar to the ECF framework to build educational profiles and, consequently, curricula and courses that both adhere to the standards required by the scientific and professional communities (e.g., IEEE, ACM), as well as to the platforms and agreements identified by the institutions. Some examples of platform creation are beginning to appear [31] but, at present, are mainly limited to experiences in single universities and, therefore, not ready to be exported. We need platforms that ensure the construction of courses of studies whose contents are fresh and relevant. Unfortunately, the construction of course contents does not follow this process very often and this situation increases the gap between education and companies’ needs.

### C. Smart Processes

Smart courses and smart universities are like two sides of the same coin: one cannot exist without the other. In other words, smart courses can promote smart universities and smart universities can promote smart courses. From the organizational standpoint a university becomes smart when (i) it contains less bureaucracy, (ii) facilitates the creation of smart human social capital, and (iii) supports innovative investments fostering synergy between teaching and research. These aspects of university life have been measured over and over inside each university system. However, those measures have not always been an effective tool for modifying the process model fast enough. Therefore they did not help universities to evolve in a reasonable amount of time. Those metrics have not often helped in maintaining fresh and updated course contents, in building networks of supports of local and non-local companies or in creating new companies, and in promoting the direct participation of companies in terms of input acquisition to use in educational choices. Those measures have not increased the participation in scientific and social responsibilities of new and existing enterprises.

To conclude, a smart course can help turn a university into a smart-university with its ability to form talents and, indirectly, to develop innovations that can become the startup for something new. A smart course creates jobs since it promotes a vision that is not limited to the simple acquisition of knowledge, but aims to create culturally qualified personnel by anticipating users’ demands.

### IV. THE MODEL OF A SMARTER UNIVERSITY

The starting point to define the model of a smarter university is represented by a shared vision among the various stakeholders (i.e., teachers, students, administration, nonprofit organizations, research institutions, citizens, industries, etc.)

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2 http://ec.europa.eu/education/tools/ects_en.htm
derived from the analysis of the territory (i.e., industrial reality, colleges and universities in close distance, types of schools, etc.), from the type of cultural areas that require intervention, and, above all, from the university strengths that can be applied in the territory in terms of social, economic, and cultural instances (both real or virtual).

During this preliminary phase of “opinion mining”, which can also be conducted using a “jam session” within social network sites (e.g., Facebook, Twitter, etc.), the active participation of citizens is fundamental. Their involvement must start at an early stage so as to ensure the consensus throughout the implementation of the entire operational plan and to guarantee that the plan is derived from a real need expressed by the territory. This procedure resembles the process of consensus building adopted for the development of a smart city.

Based on the above consideration, the definition process of a smarter university is derived from the model commonly used for the design of smart cities [32]. The proposed model is sketched in Figure 1 and the relevant components and their roles are described in this section.

![Diagram of Smarter University Model](https://www.collaborationjam.com)

- **Opinion mining** – The first step of the process is collecting different opinions, which will be later organized and structured. This approach is similar to the one used by the Coventry City Council in an experiment conducted by IBM. The trial aimed to produce the vision of a smart city and started by using participation from the bottom up. This step is a very delicate one and should be treated with particular care, because the vision of a smarter university produced will have a medium-long term impact on the future of an entire area. At the same time, the same vision must produce a return even in the short term. Research organizations and industries in the considered area, due to their competencies, should also participate in this phase and help drawing a clear roadmap.

- **Needs collection** – The second phase of the proposed model corresponds to an in-depth analysis of the needs emerging from the area, the communities and the organizations. In this step, the collected views are organized and structured according to their sources (stakeholders). These views are then translated into specifications and constraints of the system. The system generated in this phase is complex and has multiple input variables (both dependent and independent) as well as many constraints. A simulation of the system model at this stage is a challenge since it requires the study of a non-linear system, which provides a complex solution, assuming that a feasible solution exists. Nevertheless, the production of a simulation should not be dismissed.

- **Vision** – The presence of multiple variables and constraints encourages the creation of a “strategic” vision that must be translated into clear objectives, ambitious yet realistic. The objectives should clearly state the expected achievements in the medium and long term. Therefore, the strategic vision is structured with measurable objectives, a set of goals $G = \{\text{Goal}_1, \text{Goal}_2, ..., \text{Goal}_N\}$, whose reach is measured through the set $K = \{\text{KPI}_1, \text{KPI}_2, ..., \text{KPI}_N\}$ of relevant Key Performance Indicators (KPIs). The goals are to be constantly monitored and the associated KPIs allow measuring the degree of achievement of each goal. This activity of monitoring and measurement is accompanied by a parallel corrective activity used to steer the objectives of the system, if necessary. A metric plan similar to the Goal/Question/Metrics [33] can be used at this stage.

- **Priorities** – The above mentioned objectives are then ordered as a two-dimensional array according to their priority and their measure of urgency. Specifically, higher priority goals are implemented first; lesser priority and non-urgent ones follow. Goals with low priority and non-urgent goals are excluded. At this point, it is necessary to train dual thinker individuals (i.e., students). Dual thinkers have ample complete knowledge in one sector, but a general and broad knowledge in multiple domains. To achieve this objective the model identifies, on one hand, contents common to multiple domains and, on the other hand, contents specific to each domain in consideration.

- **Common contents** – The model extracts common contents, knowledge and skills that an individual must
have in multiple scientific areas, corresponding to the transverse part of T-shaped people.

- **Domain specific contents** – The vertical part of the T is represented by the knowledge and the skills that individuals must possess in a specific domain. For these domain-specific contents suited vertical courses are identified. In practice, at this stage the creation of multi-domain contents should be taken into account as well. These multi-domain contents may not be directly derivable from the previous step and might not be even vertical. For example, let us assume we are interested in forming the non-existent figure of an e-leader. In which domains should we seek the knowledge and skills for such a figure? Probably, those domains will include ICT, business, and leadership. In other words, this step is crucial for the formation of T-skilled skills, for both the vertical part and the completion of the horizontal one of the T shape.

- **Competences, standards and policies** – On the right side of the model depicted in Figure 1, the competencies are described in the ECF and teachers’ skills are taken into account. In regard to the ECF, it is worth noting that in Italy the government agency, “Agency for the Digital Italy”, not only has adopted the ECF 3.0 standard but it has also made it UNI 11506. This means that all the regional digital agencies must align to this standard. Italy is one of the first countries in Europe to adhere to this revolutionary process. This adoption promotes uniformity, and produces a revolution, as well as it establishes a higher rigor, in the definitions of the competencies accepted at a European level. In addition to this standard, we consider the de facto or de jure required standards in terms of courses and contents of each major (e.g., engineering, economics), as well as the learning-related standards offered by the variety of university employees. Finally, the policies required by university management are taken into account. When this phase is completed, it is possible to evaluate the vertical paths oriented towards specific application areas.

- **Matching** – One of the most challenging parts of the model is the task of matching the choices with the needs. The complexity is not only due to the presence of requirements imposed by outside the system, but also due to the feasibility of the actions defined in the higher parts of the model. For example, it may happen that the professional figures identified by the model cannot be realized simply because there are no teachers with appropriate knowledge available. The point here is not only a simple question of supply and demand, which is an obvious role of a university. A smarter university wants also to look at the future of the professions and be ready to build them with a model that performs an appropriate matching accompanied by a corrective activity, where required. For example, assume we need to create the imaginary professional figure of an e-leader. This professional figure might have 3 types of skills: the first in ICT, the second in Business and the third in Leadership. The activity of matching in this step should be able to check the depth of the gap between the profession we desire to build and what can be accomplished realistically with the conditions and the constraints of the system (skills of the teachers, companies in the territory, prior experiences, specific associations, etc.).

- **Monitoring and analytics** – The proposed model provides an abstract representation of a vision. Its application to specific situations and environments requires the implementation of a specific structuring of each part and such a process that can be very complex. It must also be said that this model requires the help of various tools such as forecasting, simulation, data collection and analytic tools. The monitoring and data collection must be implemented in such a way that it initially performs analysis on the data collected during the trial implementation of the process and successively uses the result of the analysis to make adjustments on the process model to adapt to the needs of the system.

The presented vision of a smarter university is the vision of the future university, which responds to the students’ needs in a sustainable, social and technological way. “Being smart” should not be confused with “being digital”. The ICT infrastructures are the means, not the end, enabling a set of services that affect deeply the life of the university. For example, the availability of broadband as a resource is essential to ensure that business is more competitive and to reduce the digital divide between citizens; the availability of low-frequency short-range technologies represent an essential resource for enabling the development of the IoT [34]. Similarly, Wi-Fi technology provides a valuable tool for reaching high-frequency strategic areas such as laboratories, libraries, meeting points, and so on. Of course, wherever the interconnection of these technologies is available, it might be possible to have an effective and timely monitoring, as well as a constant update, of each student’s part of the vision.

### A. Monitoring and Analytics Tools

Since the effectiveness of a university is a complex mix of several variables related to funding, programs, staff, demographic studies, curriculum, class size, classrooms types and availability, educational content, campus reachability and livability, and so on, when these data are distributed throughout offices across campuses, it is hard to have an integrated vision unless there is an organized sharing of digital data. In such a situation, no prediction is possible.

The availability of analytic tools that put together these variables and provide warnings to students, administrators and teachers is a useful way to overcome the delicate phase of monitoring. An effective monitoring can detect beforehand problems such as students’ absence and dropout. For example, according the 2013 ANVUR (the Italian Agency of the Evaluation of the University System) “Report on the status of the Italian university system” [35], between 10%-30% of students leave university prior to the completion of their degree. Of 1,762,719 Italian students, 40.4% remains enrolled beyond the expected time for completing the degree, and in a
year are unable to reach the minimum quota of 60 credits. These are the students that fill the long list of unemployed individuals. Problems like this, however, could be diagnosed at an early stage by the monitoring phase of the model with the help of analytic tools. The individuals at risk could be reintegrated with the help of proper tutoring. However, this can happen only if the “intelligent” system is able to detect such individuals. For example, the Department of Education of Tennessee used an intelligent system, developed by IBM, for the management of students at risk of an upper secondary school in the Hamilton County. The analytic tool used collected all the existing data and, with the help of teachers, redesigned individual plans, customized curricula, and ad hoc tasks that brought the percentage of students able to complete their degree from 8% to 80% in one year [36]. This monitoring phase and the following analytic activity is even more important in a smart university system whose mission is to prepare young adults by shaping and providing them with multiple skills that will let them better compete in a market that is more and more service-oriented.

The newly required skills will need new teaching methodologies. Interaction and collaboration tools will be at the core of these methodologies. These new methods are important for two reasons. First, they transform a traditional course into a more interactive one that aims to increase concept retention in students. Second, they help developing and shaping the skills of the XXI century that will change the way in which students learn and work. Some of these skills are: problem-solving skills; adaptability; technology management; economics; as we observe in many companies’ job searches. Another example of an intelligent experience is the Teachers TryScience initiative, supported by IBM. It is a project for the creation of a web site for teachers that provides free and engaging lessons, along with teaching strategies and resources, and events at the New York Hall of Science (NYSCI), designed to spark K-12 students’ interest in Science, Technology, Engineering and Math (STEM).

B. Efficiency

In addition to this, the model of a smarter university assumes the existence of an efficient university administration open to continuous changes. This is a real critical point across multiple university systems. Each university should be able to control all its parts from a “single virtual automated room”, thanks to analytic and forecasting platforms that should help in managing the risks, the financial exposures, and anything else. A few initial experiments that support our vision have been set in place by some universities that attempt to be smarter. The results are encouraging. For example, the University of California has developed a risk management system that involves 10 campuses and 5 medical universities. By forecasting, managing and scheduling the risks, and by using simulations of activities, the participating universities have reduced by 39% their expenses, and reduced the insurance costs by 167 million dollars since 2006. North Carolina State University uses a cloud computing system to manage all the 250,000 students belonging to the entire educational system of the state public schools, including colleges and universities. This offers to the state of North Carolina and to the university system a considerable savings in terms of cost of infrastructures.

Last but not least, a smarter university must be efficient even in term of energy. Smarter universities set in place plans for sensor-guided automated lights that turn on/off when necessary. Data analytics are run to detect deficiencies or problems that can be tuned to save money in electricity bills. Those savings can be later reinvested in teaching and new cloud based infrastructures. This is what Kent State University, Tulane University, Syracuse University, and other American universities have done: a significant step towards the creation of a sustainable territory.

V. Conclusions

Currently, universities can be regarded as smart universities, as they profitably use available technologies to improve their performance and to enhance the quality of their graduates. Such smart universities act in the context of smart cities, which offer smart services and applications to their citizens to enhance their quality of life. Despite this, there is still space for improvement and universities should become smarter universities. In brief, the infrastructure and the model of the universities are already some how smart. To become smarter, we need a step forward in this direction from students, teachers, and all the other people involved in education. In a smarter university the ultimate technological solutions foster collaboration and cooperation among individuals.

In this paper we have outlined a process model where people’s needs are analyzed, and a set of goals are identified. Then the university acts to satisfy those goals, which represent current and/or future needs. Each goal is associated with a KPI so that the process can be monitored and tracked by means of suited analysis tools. In future work we will address how to improve this model and we will analyze and define accurate indicators for a better evaluation and assessment of the whole process.

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